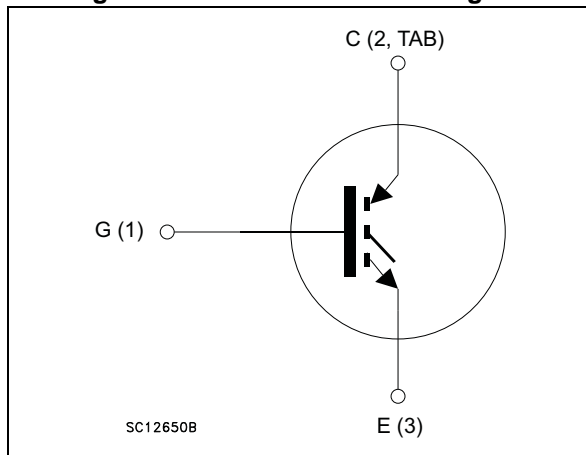


Figure 1. Internal schematic diagram



Features

- Maximum junction temperature: $T_J = 175\text{ }^\circ\text{C}$
- High speed switching series
- Minimized tail current
- Very low saturation voltage: $V_{CE(sat)} = 1.6\text{ V}$ (typ.) @ $I_C = 40\text{ A}$
- Tight parameters distribution
- Safe paralleling
- Low thermal resistance
- Lead free package

Applications

- Photovoltaic inverters
- High frequency converters

Description

This device is an IGBT developed using an advanced proprietary trench gate and field-stop structure. The device is part of the new HB series of IGBTs, which represent an optimum compromise between conduction and switching losses to maximize the efficiency of any frequency converter. Furthermore, a slightly positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in safer paralleling operation.

Table 1. Device summary

Order code	Marking	Package	Packaging
STGW40H65FB	GW40H65FB	TO-247	Tube
STGFW40H65FB	GFW40H65FB	TO-3PF	Tube
STGWT40H65FB	GWT40H65FB	TO-3P	Tube

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3	Test circuits	10
4	Package mechanical data	11
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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-247, TO-3P	TO-3PF	
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	650		V
I_C	Continuous collector current at $T_C = 25\text{ °C}$	80		A
I_C	Continuous collector current at $T_C = 100\text{ °C}$	40		A
$I_{CP}^{(1)}$	Pulsed collector current	160		A
V_{GE}	Gate-emitter voltage	± 20		V
P_{TOT}	Total dissipation at $T_C = 25\text{ °C}$	283	62.5	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ °C}$)		3.5	kV
T_{STG}	Storage temperature range	- 55 to 150		$^{\circ}\text{C}$
T_J	Operating junction temperature	- 55 to 175		$^{\circ}\text{C}$

1. Pulse width limited by maximum junction temperature.

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		TO-247 TO-3P	TO-3PF	
R_{thJC}	Thermal resistance junction-case	0.53	2.4	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance junction-ambient	50		$^{\circ}\text{C}/\text{W}$

2 Electrical characteristics

$T_J = 25\text{ °C}$ unless otherwise specified.

Table 4. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 2\text{ mA}$	650			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$		1.6	2.0	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 125\text{ °C}$		1.7		
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $T_J = 175\text{ °C}$		1.8		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$	5	6	7	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 650\text{ V}$			25	μA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$			250	nA

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$	-	5412	-	pF
C_{oes}	Output capacitance		-	198	-	pF
C_{res}	Reverse transfer capacitance		-	107	-	pF
Q_g	Total gate charge	$V_{CC} = 520\text{ V}, I_C = 40\text{ A},$ $V_{GE} = 15\text{ V},$ see Figure 28	-	210	-	nC
Q_{ge}	Gate-emitter charge		-	39	-	nC
Q_{gc}	Gate-collector charge		-	82	-	nC

Table 6. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 5\ \Omega$, $V_{GE} = 15\text{ V}$, see Figure 27	-	40	-	ns
t_r	Current rise time		-	13	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2413	-	A/ μ s
$t_{d(off)}$	Turn-off delay time		-	142	-	ns
t_f	Current fall time		-	27	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	498	-	μ J
$E_{off}^{(2)}$	Turn-off switching losses		-	363	-	μ J
E_{ts}	Total switching losses	-	861	-	μ J	
$t_{d(on)}$	Turn-on delay time	$V_{CE} = 400\text{ V}$, $I_C = 40\text{ A}$, $R_G = 5\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 175\text{ }^\circ\text{C}$, see Figure 27	-	38	-	ns
t_r	Current rise time		-	14	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	2186	-	A/ μ s
$t_{d(off)}$	Turn-off delay time		-	141	-	ns
t_f	Current fall time		-	61	-	ns
$E_{on}^{(1)}$	Turn-on switching losses		-	1417	-	μ J
$E_{off}^{(2)}$	Turn-off switching losses		-	764	-	μ J
E_{ts}	Total switching losses	-	2181	-	μ J	

1. Energy losses include reverse recovery of the external diode. The diode is the same of the co-packed STGW40H65DFB.
2. Turn-off losses include also the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2. Power dissipation vs. case temperature for TO-247 and TO-3P

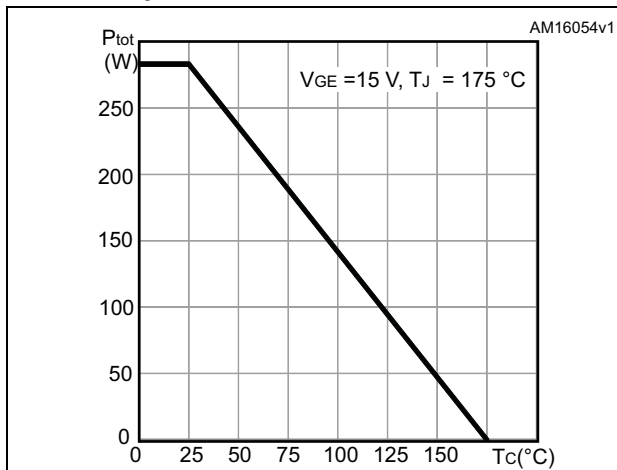


Figure 3. Collector current vs. case temperature for TO-247 and TO-3P

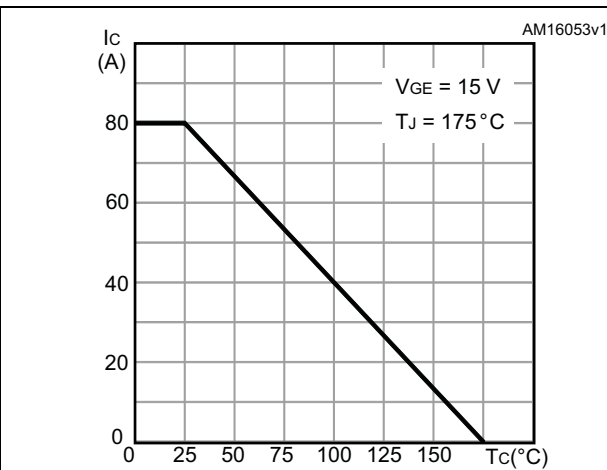


Figure 4. Power dissipation vs. case temperature for TO-3PF

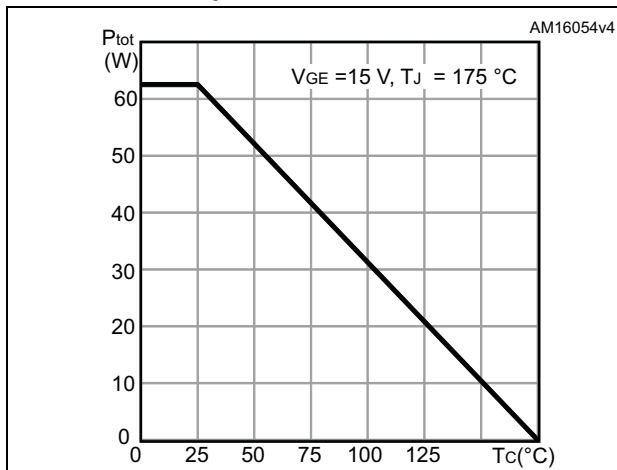


Figure 5. Collector current vs. case temperature for TO-3PF

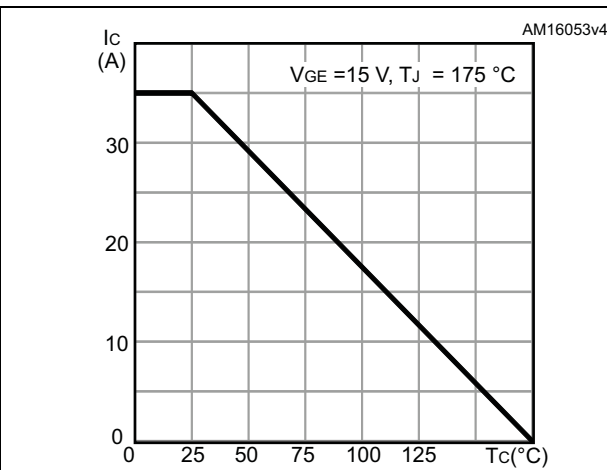


Figure 6. Output characteristics ($T_J = 25^\circ\text{C}$)

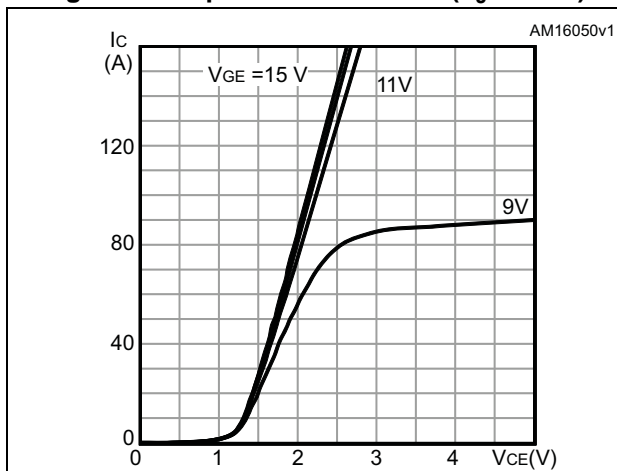


Figure 7. Output characteristics ($T_J = 175^\circ\text{C}$)

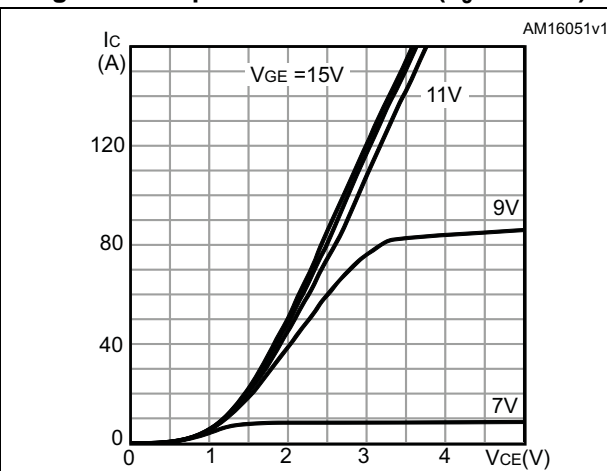


Figure 8. $V_{CE(sat)}$ vs. junction temperature

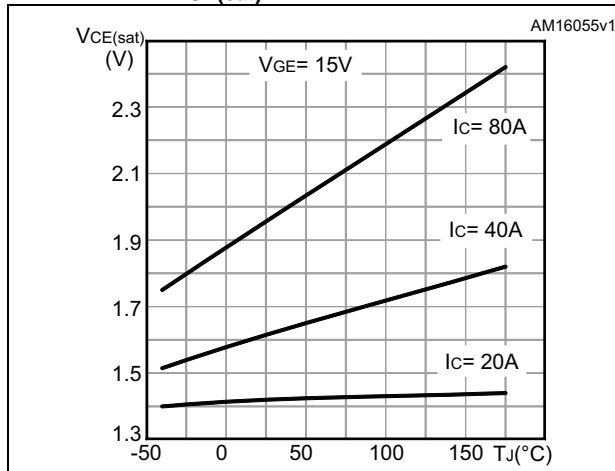


Figure 9. $V_{CE(sat)}$ vs. collector current

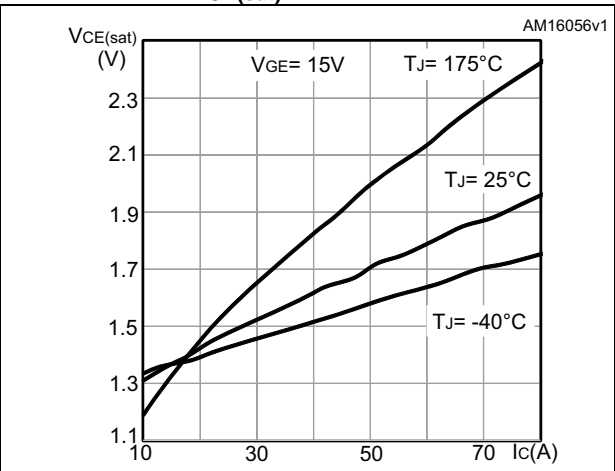


Figure 10. Collector current vs. switching frequency for TO-247 and TO-3P

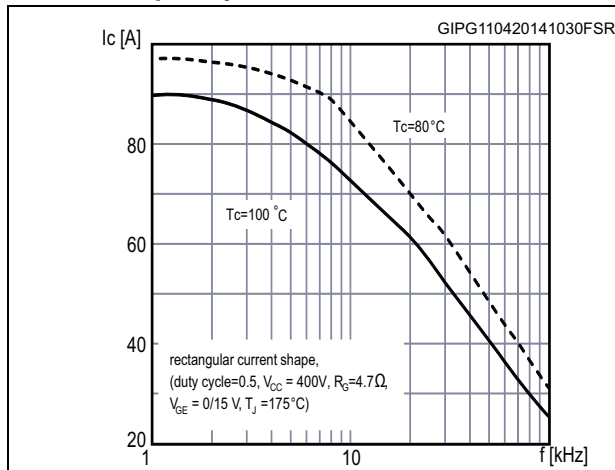


Figure 11. Collector current vs. switching frequency for TO-3PF

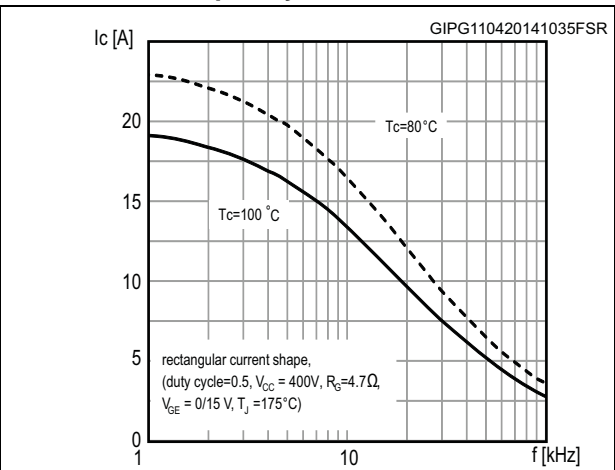


Figure 12. Forward bias safe operating area for TO-247 and TO-3P

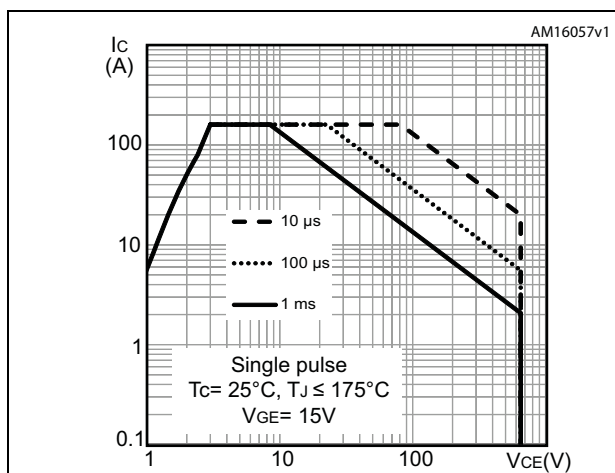


Figure 13. Forward bias safe operating area for TO-3PF

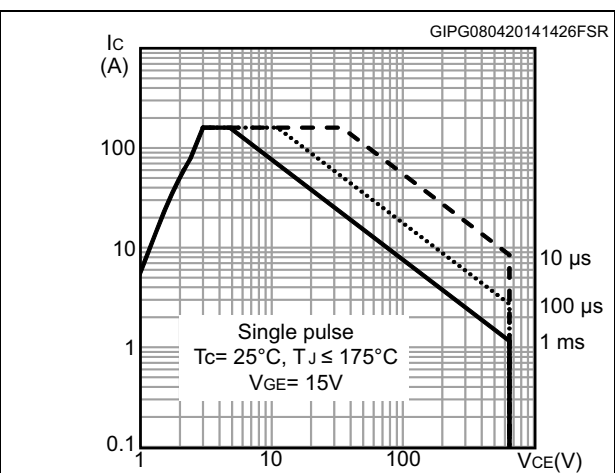


Figure 14. Transfer characteristics

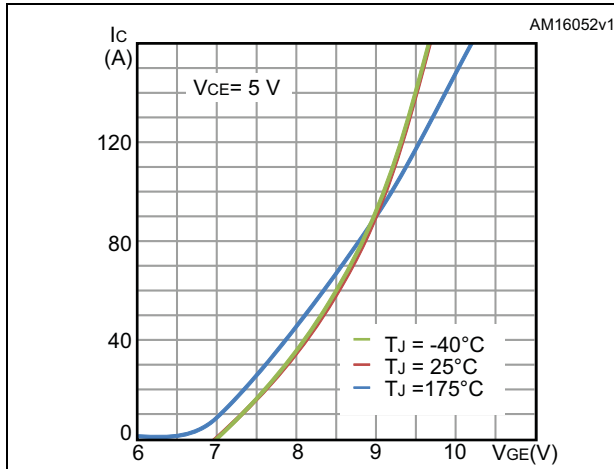


Figure 15. Normalized $V_{GE(th)}$ vs junction temperature

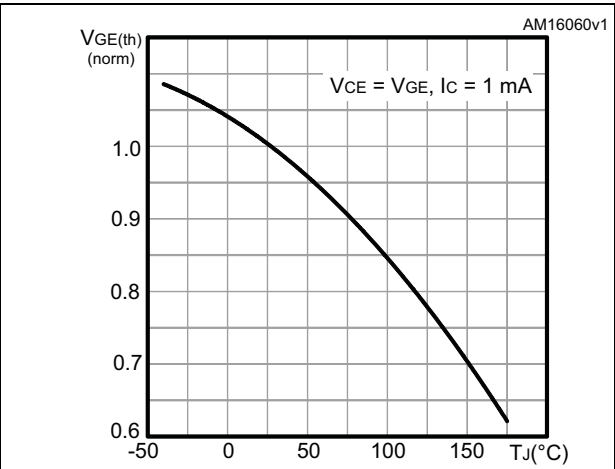


Figure 16. Normalized $V_{(BR)CES}$ vs. junction temperature

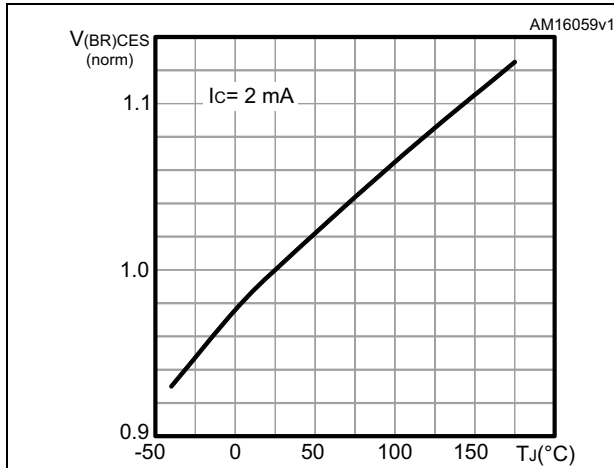


Figure 17. Capacitance variation

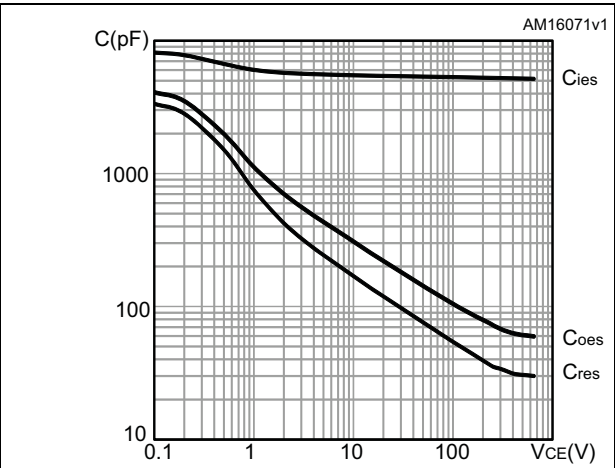


Figure 18. Gate charge vs. gate-emitter voltage

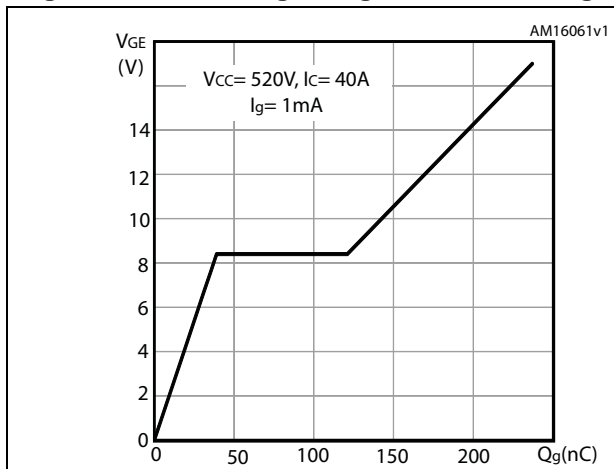


Figure 19. Switching loss vs collector current

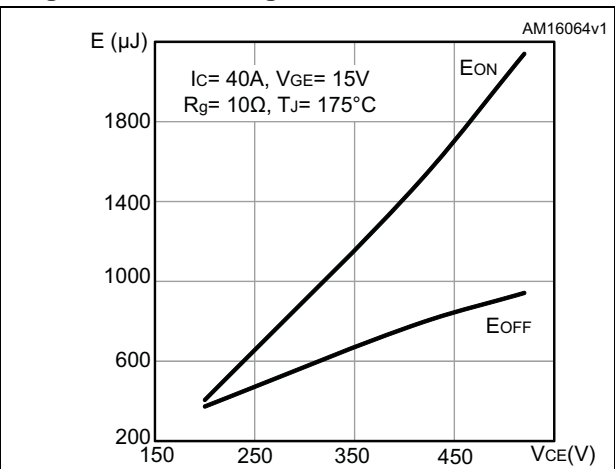


Figure 20. Switching loss vs gate resistance

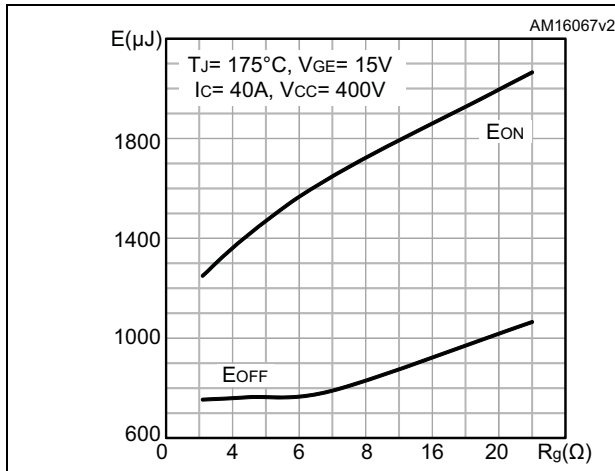


Figure 21. Switching loss vs temperature

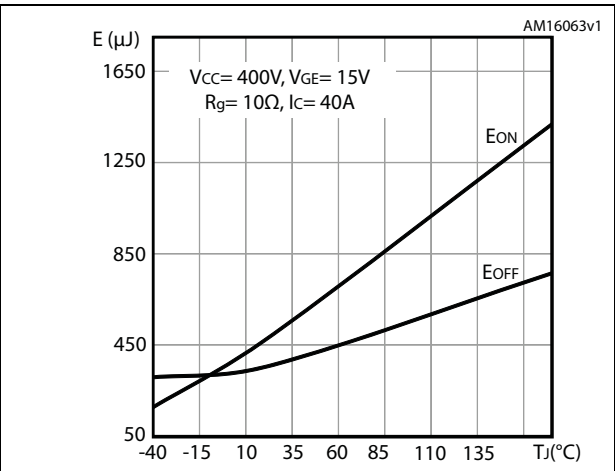


Figure 22. Switching loss vs collector-emitter voltage

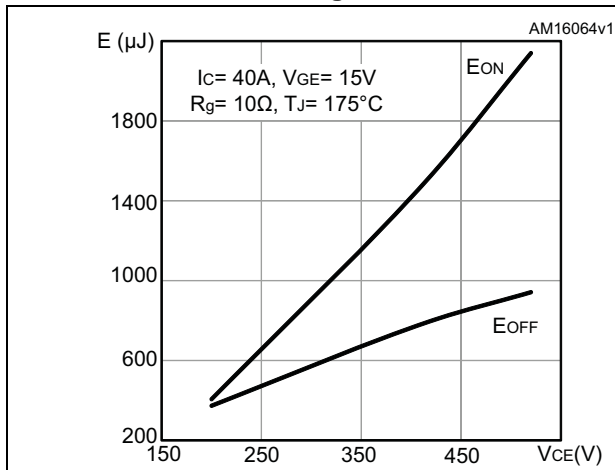


Figure 23. Switching times vs. collector current

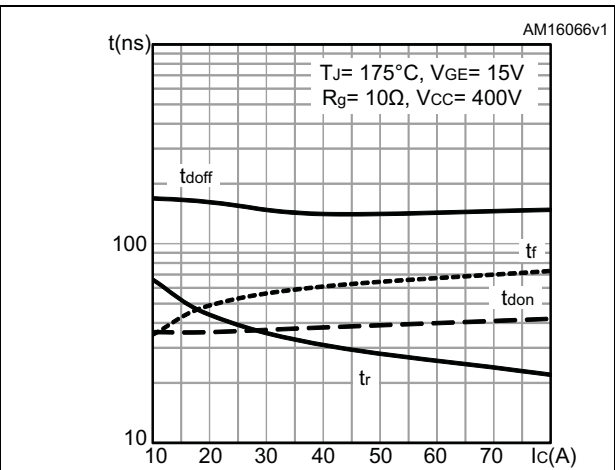


Figure 24. Switching times vs. gate resistance

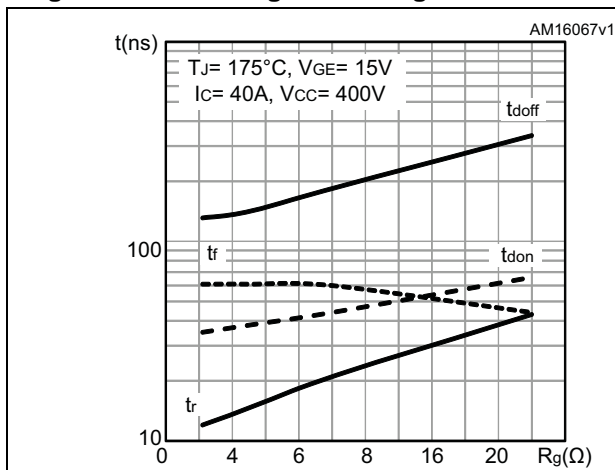


Figure 25. Thermal impedance for TO-247 and TO-3P

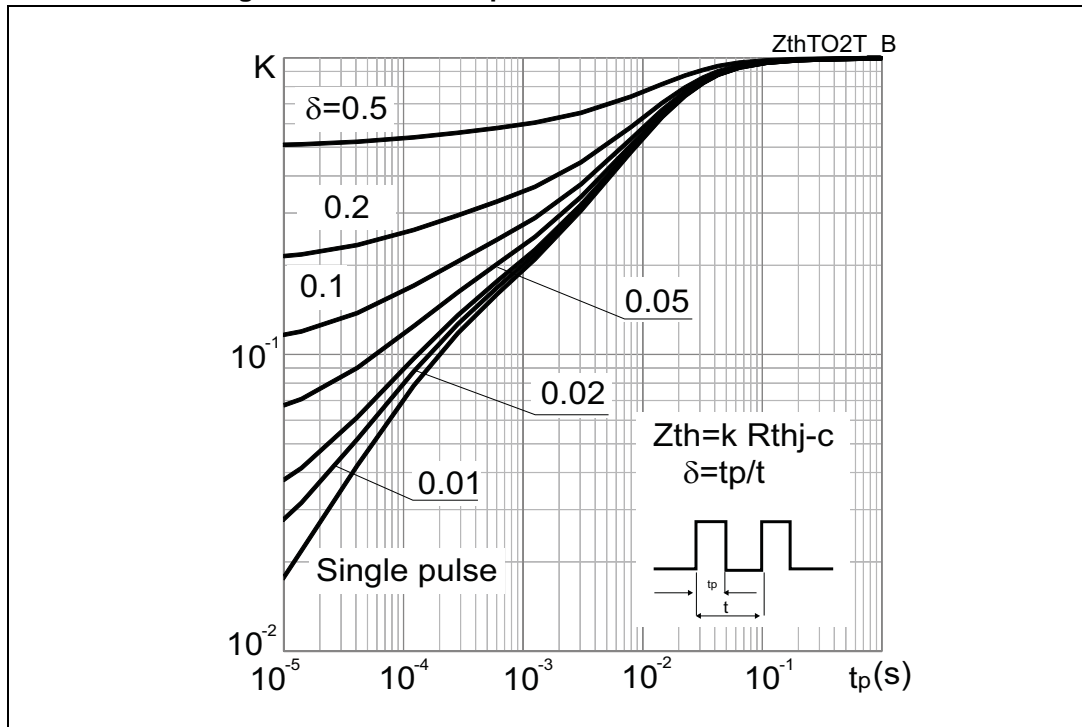
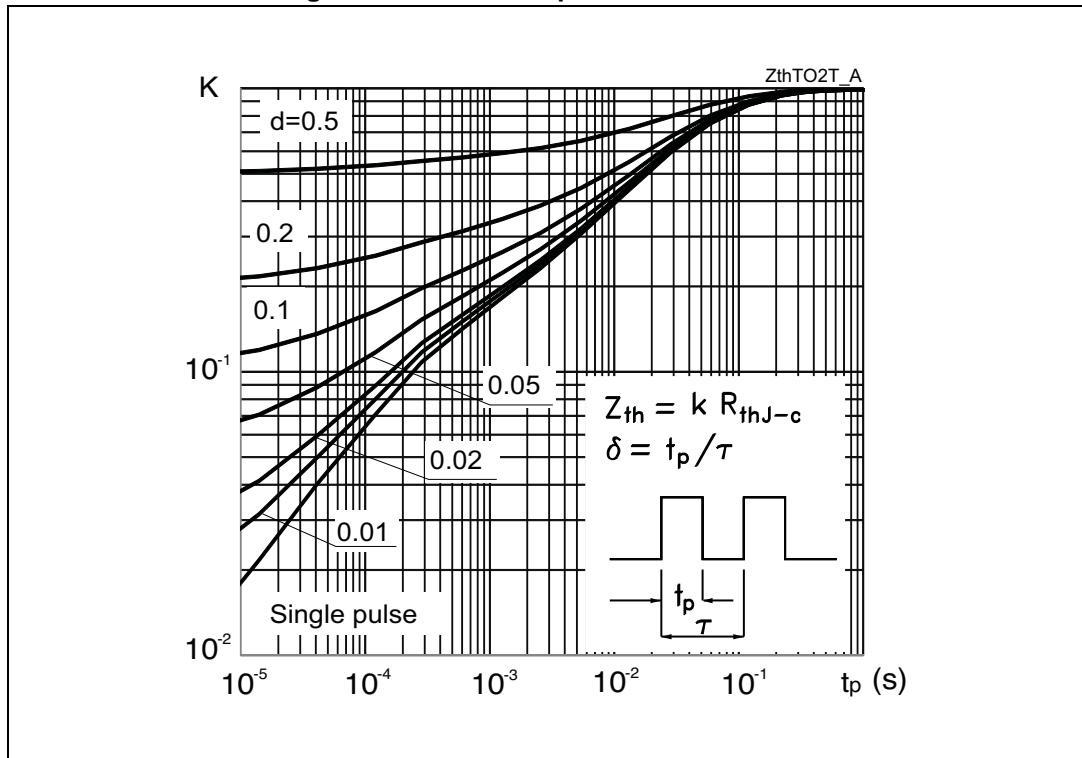


Figure 26. Thermal impedance for TO-3PF



3 Test circuits

Figure 27. Test circuit for inductive load switching

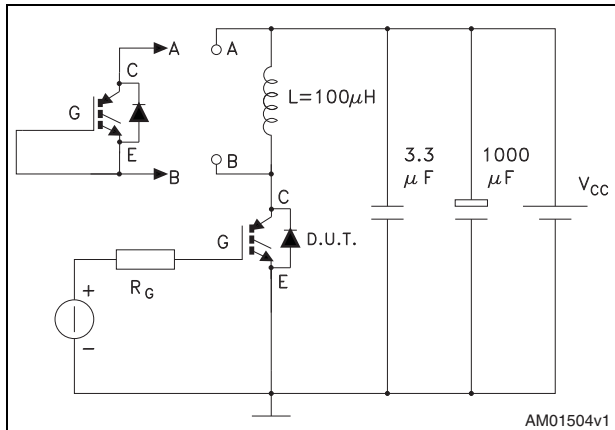


Figure 28. Gate charge test circuit

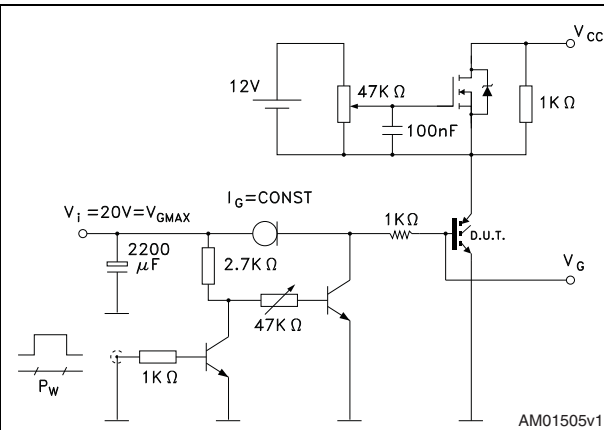
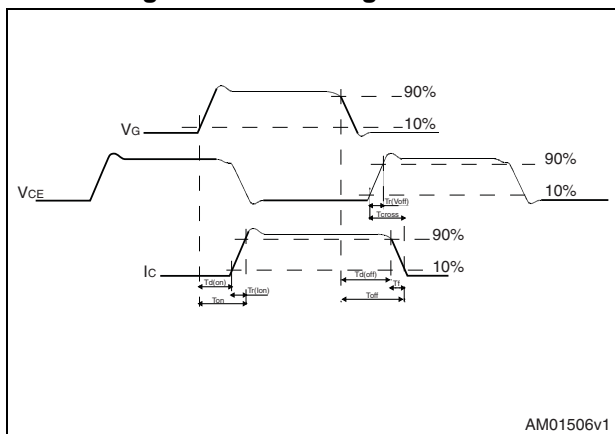


Figure 29. Switching waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

4.1 TO-247, STGW40H65FB

Figure 30. TO-247 drawing

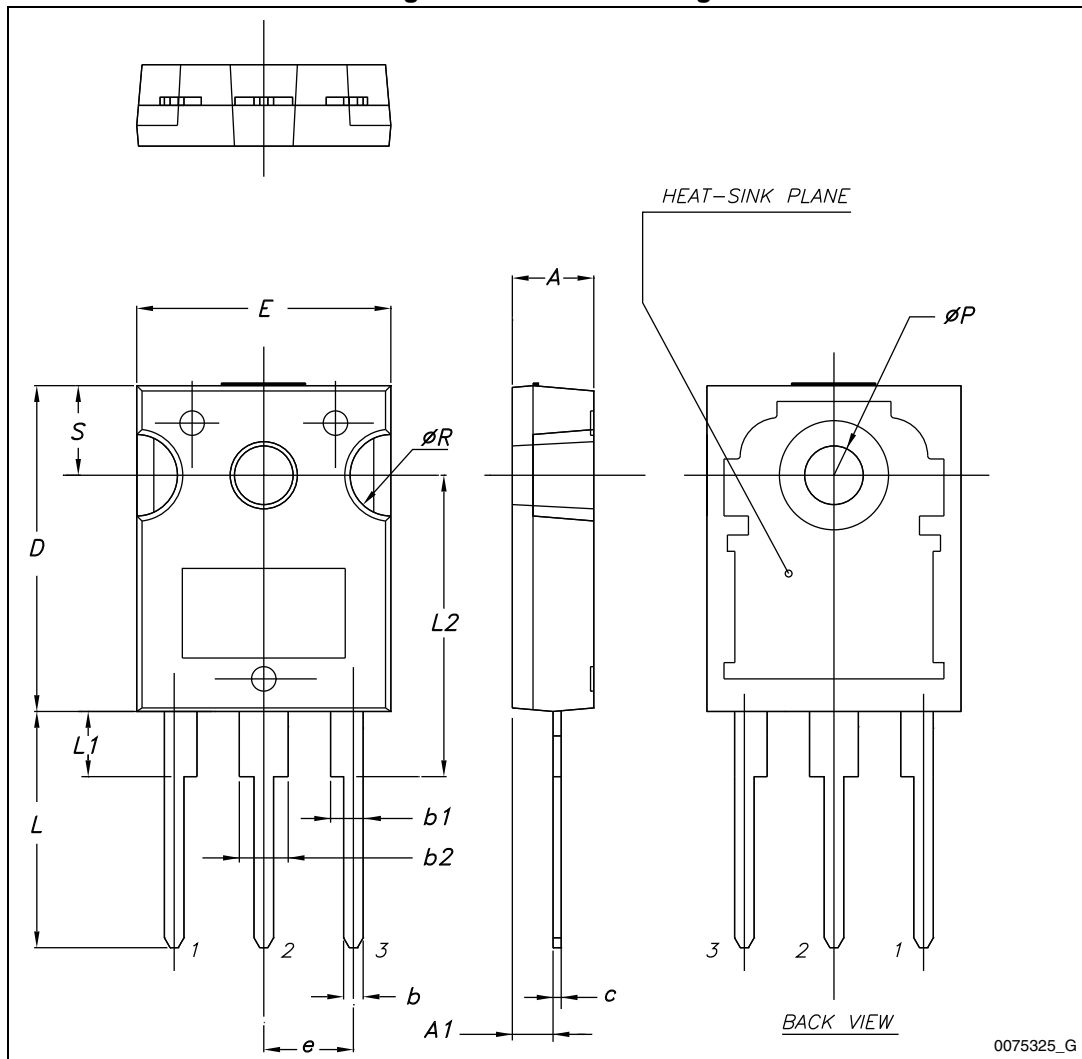
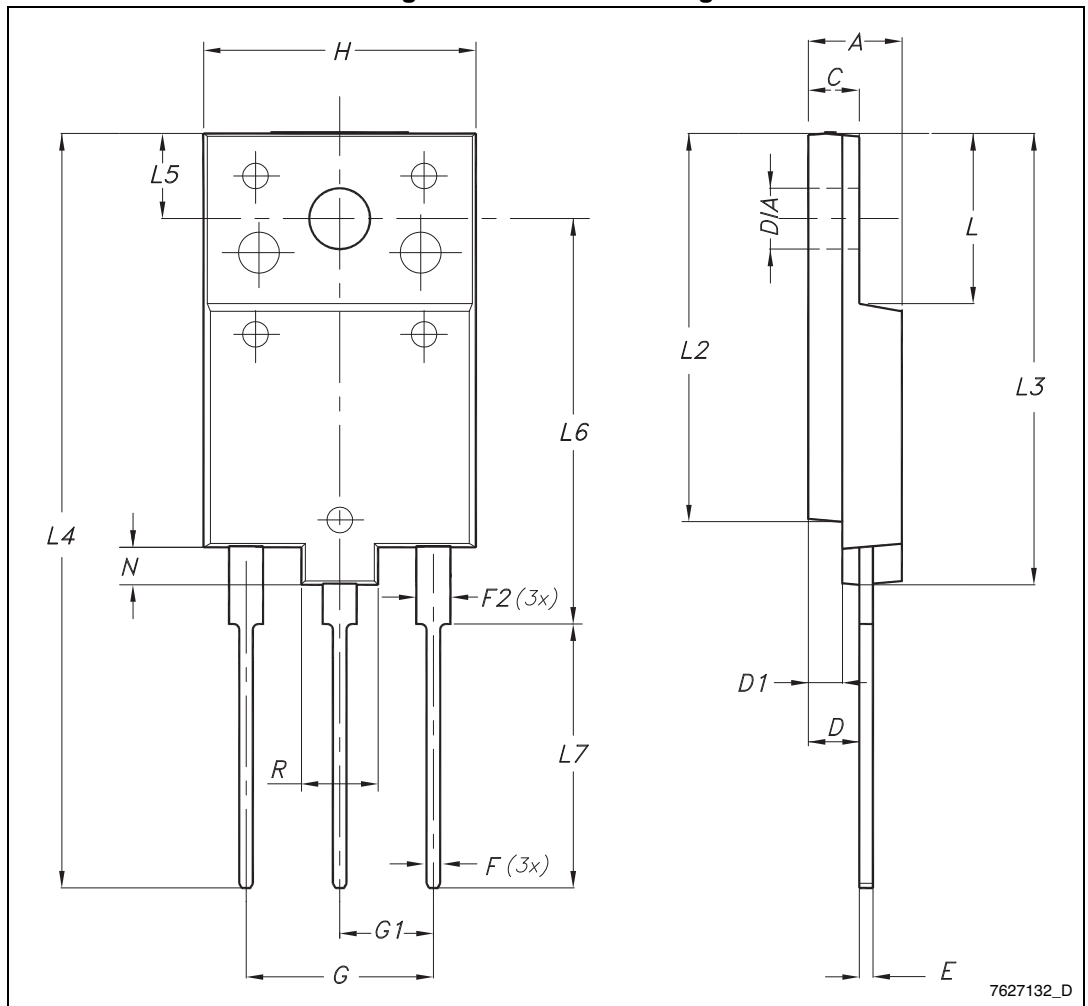


Table 7. TO-247 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

4.2 TO-3PF, STGFW40H65FB

Figure 31. TO-3PF drawing



7627132_D

Table 8. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

4.3 TO-3P, STGWT40H65FB

Figure 32. TO-3P drawing

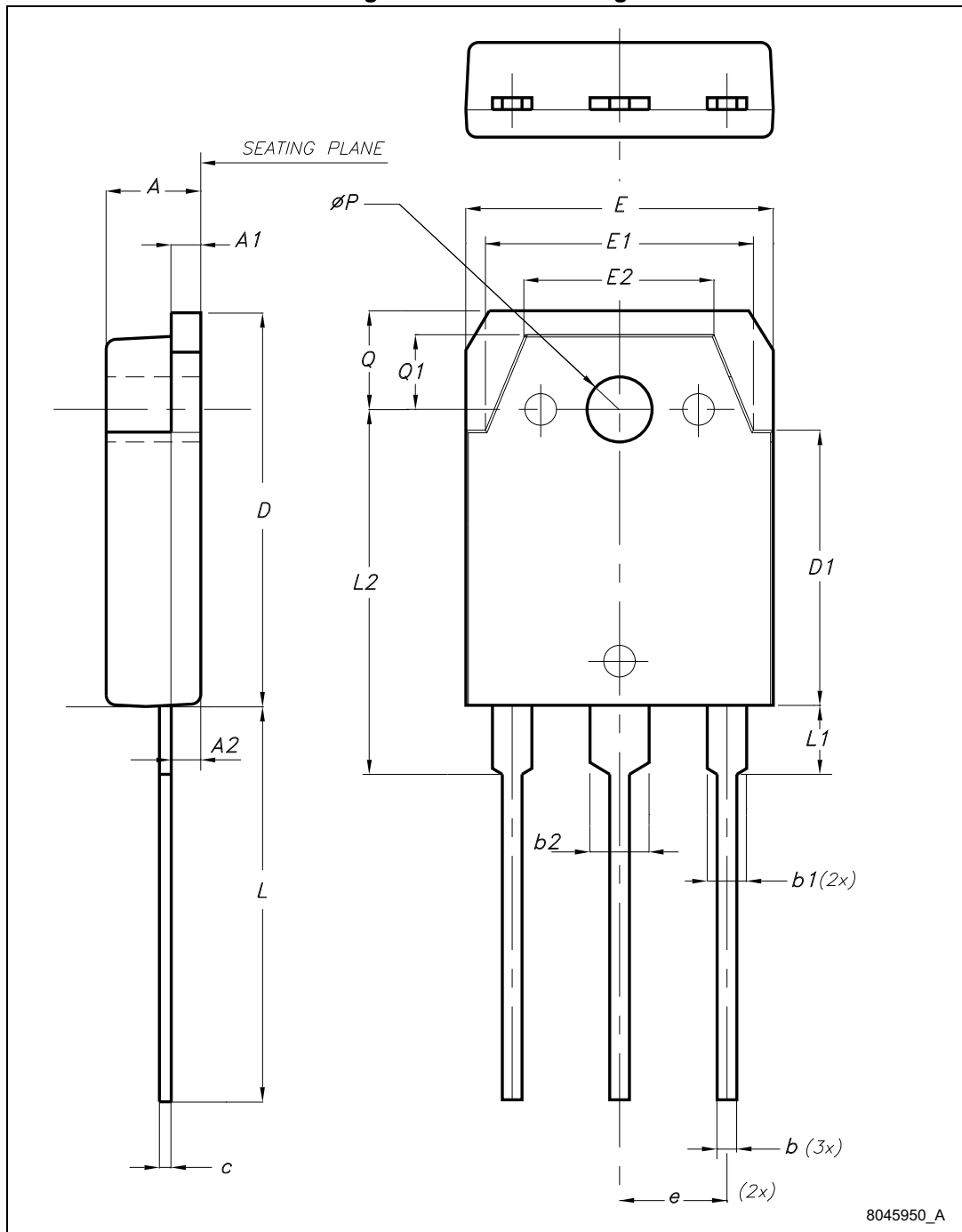


Table 9. TO-3P mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60		5
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1	1.20
b1	1.80		2.20
b2	2.80		3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
D1		13.90	
E	15.40		15.80
E1		13.60	
E2		9.60	
e	5.15	5.45	5.75
L	19.50	20	20.50
L1		3.50	
L2	18.20	18.40	18.60
øP	3.10		3.30
Q		5	
Q1		3.80	

5 Revision history

Document

Table 10. Document revision history

Date	Revision	Changes
30-Aug-2013	1	Initial release.
11-Sep-2013	2	Document status changed from preliminary to production data. Inserted Section 2.1: Electrical characteristics (curves) .
28-Feb-2014	3	Updated title and description in cover page.
05-Mar-2014	4	Updated units in Table 6: Switching characteristics (inductive load) .
11-Apr-2014	5	Added part number and references for the device in a TO-3PF package

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